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CORRECTIVE ACTION PLAN FOR SITE 6 BUILDING 648 ZONE H SITE IDENTIFICATION NUMBER 17784 WITH TRANSMITTAL CNC CHARLESTON SC

5/1/2001

CH2M HILL

CORRECTIVE ACTION PLAN
FOR
Site 6, BUILDING 648, ZONE H

Site Identification # 17784

Charleston Naval Complex
North Charleston, South Carolina

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

Contract Number N62467-99-C-0960

May 2001

D H E C
PROMOTE PROTECT PROSPER
2600 Bull Street
Columbia, SC 29201-1708

12 November 1999

Department of the Navy
Southern Division NFEC
P.O. Box 190010
North Charleston, SC 29419-9010
Attention: Mr. Gabriel Magwood

Re: Final Assessment Report dated 30 September 1999
Zone H/Site 6-Building 648 (Site Identification # 17784)
Charleston Naval Complex/Charleston Naval Base
Charleston, SC
Charleston County

Dear Mr. Magwood:

The author has completed technical review of the referenced document. As submitted, the report provides a narrative and summary of previous assessment activities and analytical results from additional sampling conducted to establish the environmental fate of suspected contamination at the subject property. The analytical results presented and applied interpretations appear to indicate that a reasonable delineation and characterization of the extent and severity of soil and groundwater contamination have been developed for the Building 648 site. This information and data were then utilized in evidential discussion(s) for consideration of employing free product source removal (groundwater contamination) and monitored intrinsic remediation (natural attenuation/biodegradation) as the rehabilitation strategy for the referenced site.

The Department considers the goal of groundwater corrective actions as the restoration of impacted waters to a quality consistent with the use associated with the described water class in a reasonable and timely manner. As groundwaters of the State are currently classified as Class GB (underground source of drinking water), the appropriate remedial goal for this site will be the quality standards established in R.61-68 (Water Classifications and Standards), if reasonably and technically attainable, utilizing available technology. Selection of a remedial alternative necessary to attain the above classification must be technically justified and demonstrate appropriate protection of human health and the environment, prevent continued migration of contamination, reduce the mass of contaminants in all affected media and have predictable/measurable parameters sufficient to demonstrate the efficacy of the remedial alternative implemented.

Although the author concurs with the proposed free product remedial endeavors, proposals that incorporate monitored natural attenuation must provide sufficient data to demonstrate the groundwater environment's assimilative capacity to provide for intrinsic biodegradation/natural

attenuation for the known contaminants through time. Appropriate and reasonable data must be available/developed to demonstrate contaminant plume stability, contaminant stoichiometry and provide site specific information/data on attenuation (retardation and degradation) rates to verify predictive modeling applied to the site. Associated routine monitoring (groundwater and soil, as necessary) should be sufficient to demonstrate the rate and effectiveness (if any) of predicted degradation processes in effect and able to distinguish the effects of nondestructive processes (advection, dispersion, sorption, etc.) and destructive attenuation processes.

With consideration to the above, the facility should evaluate available data and submit an appropriate CAP (corrective action plan) sufficient to address the identified concerns discussed above. A schedule for development of the requested CAP should be submitted to my attention by 31 December 1999. Should you have any questions please contact me at (803) 898-3559

Sincerely,

Paul L. Bristol, Hydrogeologist
Groundwater Quality Section
Bureau of Water

cc: Trident District EQC

D H E C
PROMOTE PROTECT PROSPER

)0 Bull Street
Columbia, SC 29201-1708

24 April 2001

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FEC
GABRIEL MAGWOOD
P.O. BOX 190010
N. CHARLESTON SC 29419-9010

Re: Zone H Site 6, Building 648
Site Identification # 17784
Groundwater Sampling request received 18 April 2001
Charleston County

Dear Mr. Magwood:

The Department has completed the review of the referenced request. Implementation of the requested groundwater sampling event may proceed immediately. Please provide a monitoring report to the Department upon completion of the sampling event.

Should you have any questions, please contact me at 803-898-3553 (office phone), 803-898-3795 (fax) or bishopma@columb32.dhec.state.sc.us.

Sincerely,

Michael Bishop, Hydrogeologist
Groundwater Quality Section
Bureau of Water

cc: Trident District EQC
Mihir Mehta – SCDHEC BLWM
Brian Crawford, Charleston Naval Complex, 1848 Ave. F, North Charleston, SC 29405
Technical File

CORRECTIVE ACTION PLAN
FOR
Site 6, BUILDING 648, ZONE H

Site Identification # 17784

Charleston Naval Complex
North Charleston, South Carolina

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
Charleston, South Carolina 29406

Submitted by:
CH2M-JONES, LLC.
Charleston Naval Complex
1849 Avenue F
North Charleston, South Carolina 29405

JA JONES
ENVIRONMENTAL
SERVICES

CH2MHILL

Contract Number: N62467-99-C-0960

May 2001

ACRONYMS

AST	Aboveground Storage Tank
bls	below land surface
BTEX	benzene, toluene, ethylbenzene and xylenes
BRAC	Defense Base Realignment and Closure Act
CAP	Corrective Action Plan
CNC	Charleston Naval Complex
COC	Chemical of Concern
DPT	Direct Push Technology
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
GEL	General Engineering Laboratories
µg/kg	microgram per kilogram
µg/L	microgram per liter
NAVFAC	Naval Facilities Engineering Command
OVA	Organic Vapor Analyzer
PAH	Polycyclic Aromatic Hydrocarbons
QA	Quality Assurance
QC	Quality Control
RA	Rapid Assessment
RAR	Rapid Assessment Report
RBSL	Risk-Based Screening Level
RCRA	Resource Conservation Recovery Act
RFI	RCRA Facility Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SPORTENDETCHASN	Supervisor of Ship Building, Conversion and Repair, United States Navy, Portsmouth Virginia, Environmental Detachment Charleston
SSTL	Site-Specific Target Level
TTNUS	Tetra Tech NUS
US EPA	United States Environmental Protection Agency
UST	Underground Storage Tank

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICIES

1.0 INTRODUCTION

This Corrective Action Plan (CAP) has been prepared by CH2M-JONES, LLC. The plan is designed for Site 6, Building 648, Zone H; located at the Charleston Naval Complex (CNC), Charleston, South Carolina. Site 6 contains a closed underground storage tank (UST) and closed aboveground storage tank (AST) system located adjacent to Building 648 at the CNC Zone H in Charleston, South Carolina. The Rapid Assessment (RA) was performed by Tetra Tech NUS, Inc.'s (TTNUS's) on behalf of the U.S. Navy Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC).

This CAP provides a method for passive remediation at the site including groundwater monitoring to evaluate intrinsic remediation. An active method for remediation is provided as an alternative should evaluation of monitoring data indicate that intrinsic remediation is not occurring. Active remediation includes free product abatement along with excavation and removal of soil in the source area followed by groundwater monitoring as a corrective action in accordance with the South Carolina Department of Health and Environmental Control (SCDHEC) Corrective Action Guidance, June 1997. The CAP was developed using the information provided in the Rapid Assessment Report (RAR) for Site 6 prepared by TTNUS, dated September 1999. The applicable tables and figures from the RAR have been incorporated into this CAP.

1.1 General Site Description

The CNC is in the city of North Charleston, on the west bank of the Cooper River in Charleston County, South Carolina, as shown on Figure 1. This installation consists of two major areas: an undeveloped dredge materials area on the east bank of the Cooper River on Daniel Island in Berkley County, and a developed area on the west bank of the Cooper River. The developed portion of the base is on the peninsula bounded on the west by the Ashley River and on the east by the Cooper River.

The site is located within the developed portion of the base. The area surrounding CNC is "mature urban," having long been developed with commercial, industrial, and residential land use. Commercial areas are primarily west of CNC; industrial areas are primarily to the north of the base along Shipyard Creek. A Site Vicinity Map, that exhibits adjacent properties and structures, vicinity roads, current utilities, and vicinity surface drainage, is included as Figure 2.

1.2 Site Background

The CNC began operations in 1901, when the Navy acquired the property. In 1993, the CNC was added to the list of bases schedule for closure under the Defense Base Realignment and Closure Act (BRAC). BRAC regulates the closure of the base and transition of the property back to the community. With the scheduled closure of the base, environmental cleanup has proceeded to make the property available for redevelopment after closure.

Building 648 is the former Naval Base Brig that utilized UST 648B to store fuel oil which provided heating oil to the building, and AST 648 that stored diesel fuel for the building's emergency power generator. UST 648B was a 2,000-gallon steel tank and AST 648 was a 1,000-gallon steel tank. UST 648B was located approximately 15 feet north-northwest from the northwest corner of Building 648 and AST 648 was located approximately 110 feet south of UST 648B and adjacent to the west side of Building 648. The UST and AST systems for Building 648 were reportedly older than 20 years with the date of deactivation unknown [Supervisor of Ship Building, Conversion and Repair, United States Navy, Portsmouth Virginia, Environmental Detachment Charleston (SPORTENDETCHASN), 1996].

Between September 9 and October 7, 1996, UST 648B and AST 648 were removed, cleaned, and recycled as scrap metal. At the time of removal AST 648 was reported in good condition and contained no holes. UST 648 was reported to have no significant corrosion, but a 1/4-inch hole was discovered during steam cleaning of the tank. Both UST 648B and AST 648 used 5/8-inch copper piping for supply and return lines. At the time of the removal of the tanks, the copper piping was reported in good condition, a steel vent line for UST 648B was reported as severely corroded and contained numerous holes. During removal of the UST copper return lines, four abandoned 1 ½-inch diameter steel lines were discovered beneath the copper piping. The steel lines were reported as severely corroded and containing numerous holes. Product approximately ¼-inch in thickness was observed throughout the UST excavation and was attributed to the holes in the vent line (SPORTENDETCHASN, 1996). Contaminated soil encountered during the UST excavation was placed back in the tank pit. Angular rock was used to fill the area covered by the groundwater and geofabric was laid over the rock prior to returning the soil to the tank pit (SPORTENDETCHASN, 1996).

During removal of the tanks, a groundwater sample was collected from the center of the UST excavation and analyzed for petroleum constituents. Results of the analyses reported dissolved concentrations of Polynuclear Aromatic Hydrocarbons (PAHs), except dibenz(a,h)anthracene, at concentrations above the Risk Based Screening Levels (RBSLs) for chemical of concern (COC) constituents established by the SCDHEC (Risk-Based Corrective Action For Petroleum Releases, January 5, 1999). Laboratory analysis of soils reported naphthalene at concentrations above the soil RBSLs. Naphthalene exceeded the RBSLs in soils collected from the UST 648B tank pit excavation. The complete Underground Storage Tank Assessment Report for UST 648B and AST 648 is included in the September 1999 TTNUS Rapid Assessment Report (RAR). The RAR, prepared by TTNUS, dated September 1999, is summarized in Section 2.0 of this report. The RAR was approved by SCDHEC on November 12, 2000.

2.0 RAPID ASSESSMENT SUMMARY

TTNUS completed a RAR, dated September 1999, for Site 6, Building 648, Zone H. The assessment information was used to develop this CAP. The information from the RAR is summarized in this section.

2.1 Receptor Survey

A survey of the site vicinity was conducted by TTNUS personnel to identify potential receptors for petroleum hydrocarbon contamination. The Site Vicinity Map (Figure 2) depicts the public utilities located within 250 feet of the former UST 648B location. Specific information concerning the depth of utilities below land surface (bls) is currently unavailable. However, according to facility personnel, utility lines are typically located approximately 2 feet to 6 feet bls (SPORTENVDETCHASN, 1999). The following utility receptors were located:

- Water utility, sanitary sewer utility: A sanitary sewer line originates at the north end of Building 648 and extends to the northeast toward the intersection of Dyess Avenue and Darter Street. A sewer line also extends from Building 1841 and runs northeast (east of Building 648) and ties into the sewer line distribution near the intersection of Dyess Avenue and Darter Street. No sewer lines were located downgradient of Building 648 within 250 feet of UST 648B. A water utility line is located between UST 6486 and Building 648. The water line is located approximately 5 feet east of former UST 648. The water line extends north where it connects to a water main that borders the north side of Dyess Avenue.

- Storm sewer utility: A storm sewer utility lines is located beneath Building 648. The storm utility line exits beneath Building 648 near the northwest corner of the building. This utility line extends to the northwest where it connects to a storm drain system that connects a storm drain; located north west of UST 648B, to the main storm drain system that borders the south side of Dyess Avenue. The nearest storm drain line is located approximately 10 feet north of UST 648B.

A survey of groundwater users within a radius of seven miles of CNC was performed for the Final Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) Report for Zone H (E/A&H, 1996). According to this report, a survey of groundwater users a within a radius of seven miles of CNC was conducted by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. Results of the water use investigation revealed that no drinking water wells, which utilize the shallow aquifer, are located within a radius of four miles of CNC. Irrigation wells were not identified within 1,000 feet of the site. Numerous monitoring wells are located within 1,000 feet of the site. The nearest surface water body to UST 648B is the Cooper River located approximately 890 feet to the north-northeast.

There is no city, county, or state zoning ordinances as the property (CNC) is currently owned by the federal government. Information concerning zoning ordinances was obtained from the

SOUTHDIV Remedial Project Manager located at 2155 Eagle Drive, North Charleston, South Carolina.

2.2 Soil and Groundwater Assessment Information

2.2.1 Soil

Seventeen soil borings were completed as part of the screening portion of the soil investigation at Site 6. Five soil borings were completed to collect soil samples for analysis at a fixed base laboratory to confirm the COC. The soil borings for screening evaluation were completed using a Direct Push Technology (DPT) rig; and samples were collected to evaluate subsurface soil vapors, soil contaminant concentration (via a mobile laboratory), and groundwater contaminant concentrations (via a mobile laboratory). The soil samples were collected from a maximum depth of 9 feet bls. The soil and groundwater samples collected for mobile laboratory screening were analyzed for benzene, toluene, ethylbenzene, total xylenes (BTEX), and diesel range organics (DRO).

Soil samples were collected from each boring for screening analysis by mobile laboratory. The samples were analyzed for BTEX and DRO using US EPA Method 8260. The soil samples were selected based on the soil vapor screening results with the additional criteria that the samples originate in the vadose zone above the water table.

Analytical results from the mobile laboratory field screening reported toluene below detection limits in all borings. Benzene and ethylbenzene concentrations each were detected in one sample at 1.78 microgram per kilogram (µg/kg), and 6.85 µg/kg, respectively. Total xylenes of 3.04 µg/kg and 3.99 µg/kg were detected in two borings. DRO were detected in samples from six borings at concentrations ranging from 340.44 µg/kg to 284,737.55 µg/kg. Table 1 summarizes the analytical data from the mobile laboratory.

Soil samples collected for fixed base laboratory analysis were analyzed for BTEX and naphthalene using U.S Environmental Protection Agency (US EPA) Method 8260; and PAHs using US EPA Method 8270. All of the soil COCs with the exception of benzo(k)fluoranthene were reported below detection limits. Benzo(k)fluoranthene was detected in samples 06SLB0801 (403 µg/kg) at a concentration less than the RBSLs. The RBSL for clay-rich soils was used based on grain size analysis completed on sample 06SLB0607 indicating a clay-rich matrix. Soil boring locations are illustrated on Figure 3 and the results of the fixed base laboratory analysis are presented in Table 2.

2.2.2 Groundwater

A comprehensive groundwater monitoring event was conducted on March 7, 1999. Groundwater sampling was conducted using a peristaltic pump and low flow, quiescent techniques. The monitoring wells were sampled in accordance with SCDHEC guidance document "South Carolina Risk-Based Corrective Action for Petroleum Releases" (January 1998). Each well was purged of three to six well volumes or until water quality parameters of pH, temperature, and conductivity stabilized. Details of the field data sheets and field parameter measurements are available in the 1999 TTNUS RAR.

One groundwater sample was collected from each soil boring, except CNC06-P03 due to the presence of free product, and analyzed in a mobile laboratory for BTEX and DRO using US EPA Method 8260. Results of the mobile groundwater analyses are summarized in Table 3.

Benzene and ethylbenzene were reported below detection limits in all samples. Toluene was detected in three samples at concentrations ranging from 0.48 microgram per liter (µg/L) to 0.65 µg/L. A total xylenes concentration was reported in one sample at 0.72 µg/L. DRO were in samples collected from seven borings at concentrations ranging from 58.86 µg/L to1, 432.74 µg/L.

Groundwater samples were analyzed for BTEX, MTBE, and naphthalene using US EPA Method 8260 and PAH using US EPA Method 8270. Only one of the groundwater COCs, naphthalene, was detected above method detection limits in groundwater samples. Naphthalene was detected at a concentration of 1.38 µg/L and is less than the RBSL for groundwater of 40 µg/L. Results of the fixed base groundwater analyses are summarized in Table 4.

2.2.3 Assessment Conclusions

Five groundwater monitoring events were conducted at the site between December 2, 1998 and March 7, 1999. Free product was detected in piezometers CNC06-P01 and CNC06-P03. Product thickness ranged from sheen to 0.64 foot in CNC06-P01 and from 2.77 feet to 7.29 feet in CNC06-P03. Free product was not detected in any of the remaining wells. One groundwater sampling event was conducted on March 7, 1999. No dissolved COCs were detected in any well sampled except for estimated 1.38 µg/L naphthalene in CNC06-M01 duplicate sample, which is below SCDHEC's RBSL for naphthalene.

The downgradient extent of hydrocarbon impact to groundwater has been delineated. Free product was present in piezometers CNC06-P01 and CNC06-P03 with thicknesses of 0.64 foot and 6.08 feet, respectively, in March 1999. Construction worker SSTLs were calculated to evaluate the exposure pathway for groundwater COCs. Calculated concentrations of benzene (0.31 µg/L) and naphthalene (23.35 µg/L) in groundwater in equilibrium with fuel oil at source wells CNC06-P01 and CNC06-P03 exceed the SSTLs (0.15 µg/L for benzene and 1.63 for naphthalene). No concentrations of any COCs in the compliance well (CNC06-M01) exceeded their SSTLs.

Six soil samples were collected on January 19, 1999, and analyzed for BTEX and PAHs by fixed-based laboratory. Soil concentrations were reported below SCDHEC's Risk Based Screening Levels for clay-rich soils.

2.3 Fate and Transport Modeling

TTNUS applied the Domenico model to predict the distance at which the tip of the plume is attenuated to SCDHEC RBSLs in 10 and 20 years without using degradation due to biological decay. The model estimates that after 10 years, the concentrations of benzene, toluene, and naphthalene will be 0.005 μg/L, 1.0 μg/L, and 0.010 μg/L, respectively at distances of 7.1 feet, 2.5 feet, and 0.6 feet (Figure 4). Furthermore, after 20 years, the concentrations of benzene, toluene, and naphthalene are 0.005 μg/L, 1.0 μg/L, and 0.010 μg/L, respectively at distances of 14.5 feet, 5.0 feet, and 1.2 feet (Figure 5). The Domenico 10-year and 20-year simulation spreadsheets and the site-specific data used for model are detailed in the September 1999 TTNUS RAR.

2.4 Exposure Pathway Analysis

In the RA, TTNUS evaluated the receptor characterizations of the potentially exposed populations in the vicinity of the site for both current and future use of the property and identified the potentially complete exposure pathways for those receptors. The only applicable potential pathway found was that protective of a construction worker potentially exposed to groundwater in a utility trench. Complete details of the exposure pathway analysis can be found in the 1999 TTNUS RAR.

2.5 Site-Specific Target Levels (SSTLs)

Soil SSTLs were not required because soil concentrations did not exceed RBSLs. A comparison of maximum concentrations to RBSLs is presented in Table 5. In the RA, TTNUS considered the following scenarios for the calculations of SSTLs for groundwater COCs; dermal contact with; ingestion of, or inhalation of vapors from contaminated groundwater by a construction worker in a trench. No other exposure routes pathways were considered likely threats.

Contaminant concentrations of benzene and naphthalene in groundwater exceeded the minimum calculated SSTLs protective of a construction worker in a utility trench. Therefore, the petroleum contamination detected at subject property may pose a threat to construction workers in nearby utilities. A comparison of maximum groundwater concentrations to SSTLs is presented in Table 6.

3.0 PROPOSED CORRECTIVE ACTION

The proposed corrective action is a passive remediation by monitored natural attenuation for impacted groundwater. Recent monitoring indicated that free product is no longer present. The latest round of groundwater sampling indicates that all monitoring wells are below the RBSLs and SSTLs for all petroleum constituents analyzed. If supported by continued monitoring data, intrinsic remediation and monitoring well abandonment will be implemented as a corrective action in accordance with SCDHEC Corrective Action Guidance, (June 1997). The proposed intrinsic remediation plan is described in Section 4.0. If continued monitoring is not supporting natural attenuation, an active approach will be implemented consisting of excavation and removal of impacted soil in the source area.

3.1 Soil Remediation

Because no soil contaminant concentration exceeded RBSLs in the RA, active soil remediation as a part of this CAP is not warranted at this time.

3.2 Groundwater Remediation

Groundwater samples from the latest sampling event (April 10, 2001) indicated that no groundwater concentrations exceeded the RBSLs or SSTLs for the parameters analyzed (BTEX and naphthalene). In addition, no free product was found in any of the wells during the last sampling event. Groundwater results from the April 2001 sampling event are summarized in Table 7 and the laboratory report is included as Appendix A. A Potentiometric Surface Map obtained from groundwater elevations taken during the April 10, 2001 sampling event is included as Figure 6.

Based on the latest groundwater analysis and no presence of free product at the site, the method for remediation at the site is natural attenuation with continued groundwater monitoring. The most recent groundwater sampling event showed naphthalene detections at levels above the laboratory method detection limit but below the reporting limit (and below the RBSL); therefore, PAHs will also be evaluated for intrinsic groundwater monitoring.

4.0 PROPOSED INTRINSIC REMEDIATION

This CAP provides a method for implementing intrinsic remediation and monitoring well abandonment as a corrective action in accordance with SCDHEC Corrective Action Guidance, June 1997. If active remediation is warranted, intrinsic remediation will be implemented upon completion of active remediation until contaminant concentrations decrease below RBSLs or other action levels approved by SCHDEC.

4.1 Sampling and Analysis Plan

Groundwater monitoring will occur quarterly the first year and a half or until two consecutive sampling events indicate COC concentrations are below the RBSLs at which point the site will be evaluated for no further action. Note that groundwater from the latest round of sampling that occurred on April 10, 2001 indicated all COC concentrations were either non-detect or below the reporting limit for all constituents analyzed. Due to the detection of naphthalene during the UST assessment, groundwater sampling for the presence of PAHs will be evaluated. Groundwater samples will be sent to General Engineering Laboratories (GEL) located in Charleston, South Carolina and analyzed for BTEX and naphthalene using EPA Method 8260 and PAHs by US EPA Method 8270. Natural attenuation parameters (dissolved oxygen, pH, oxidation/reduction potential, and conductivity) will also be collected in the field from all wells during each sampling event. In addition to the natural attenuation parameters obtained in the field, laboratory samples for nitrate, sulfate, alkalinity, Fe^{2+}, and Fe^{3+} will be obtained during the first round of groundwater sampling to provide additional data in support of the proposed intrinsic remediation plan.

All sampling procedures will be conducted in accordance with EPA ElSOPQAM and Ensafe/ Allen & Hoshall, Comprehensive Sampling and Analysis Plan, 1996.

4.2 Monitoring Well Installation

No new wells are proposed for the intrinsic remediation. If any wells are unusable or new wells are warranted for any other reason, the wells will be installed to the same specification as existing monitoring wells unless site conditions change and warrant otherwise.

4.3 Surveying

No new monitoring wells are scheduled to be installed as a part of the intrinsic CAP. Surveying of any new well locations will be conducted if warranted.

4.4 Soil Boring Schedule

No other soils borings are scheduled for the CAP unless site conditions change and warrant otherwise.

4.5 Monitoring Well Abandonment

All monitoring wells will be abandoned upon receiving approval by SCDHEC. The wells will be abandoned following the South Carolina Well Standards and Regulations R.61-71. The well abandonment will include grouting wells, removing stick-ups and removing all guard posts. Any well casing and screen removed will be decontaminated and disposed of as general refuse.

4.6 Reporting

Semi-annual monitoring reports will be submitted to SCDHEC. The reports will summarize and include copies of field and laboratory analytical data, intrinsic monitoring data (dissolved oxygen, pH, oxidation/reduction potential, conductivity, nitrate, sulfate, alkalinity, Fe^{2+}, and Fe^{3+}), and COC distribution and trends.

5.0 PROPOSED ACTIVE REMEDIATION

Active remediation of the site may be necessary if monitoring conducted during intrinsic remediation indicates that free product has reappeared at the site. Active remediation, if necessary, will include manual removal of free product from the water table through periodic bailing of free product from monitoring wells CNC06-P01 and CNC06-P03. If manual abatement is not achievable within 6 months of being implemented, additional active remediation activities will be performed, which would include excavation and removal of impacted soils containing free product from the source area and conducting groundwater sampling to evaluate the active remediation of the site.

5.1 Free Product Recovery

If necessary, free product will be removed by bailing free product from monitoring wells CNC06-P01 and CNC06-P031 beginning with a weekly recovery schedule. If manual free product recovery is not practical or has little effect on product abatement, additional active remediation activities will be performed, that would consist of the excavation and removal of impacted soils containing free product from the source area and conducting groundwater sampling to evaluate the active remediation of the site.

SCDHEC will be contacted prior to the implementation of the different remedial approaches at the site, if soil excavation and removal is warranted at the site.

5.2 Soil Excavation and Removal Activities

Based on the analytical results of the soil sampling from the RAR, soil excavation and removal will be performed at the site to remove suspected areas of free product. Soil will be removed in the vicinity of the water-table from the area around where the free product exists (piezometers CNC06-P01 and CNC06-P03).

A backhoe will be used for the excavation. Soil will be loaded into trucks for appropriate disposal. An OVA will be used in the field to further aid field personnel in delineating the impacted area during excavation activities. Field personnel will not enter the excavation. Confirmation samples will be collected from the bucket of the excavating equipment to verify that the free product source area has been effectively removed.

Prior to excavating, the utilities will be cleared by local utility markers. Hand digging will be performed prior to backhoe excavation to determine the exact locations of utility pipes.

5.3 Sampling and Analysis Plan

Once free product has been removed from the site, groundwater samples will be collected from all monitoring wells. All groundwater monitoring will occur as stated in Section 4.6 of this report.

5.4 Reporting

Semi-annual monitoring reports will be submitted to SCDHEC. The reports will summarize and include copies of field and laboratory analytical data, intrinsic monitoring data and COC distribution and trends. Upon completion of active remediation, a Performance Evaluation Report will also be submitted to SCDHEC to summarizes the remediation activities, evaluate the soil quality data, and provide recommendations for the site.

5.5 Equipment Decontamination

All drilling equipment, augers, well casing and screens, and soil and groundwater sampling equipment involved in field sampling activities will be decontaminated according to the EPA EISOPQAM.

5.6 Sample Handling

Sample handling will be conducted in accordance to the following references: EPA EISOPQAM, Code of Federal Regulations 136, 1990, and EPA Users Guide to Contract Laboratory Program, 1988. The following forms will be completed for packing/shipping process: sample labels, chain-of-custody labels, appropriate labels applied to shipping coolers, and chain-of-custody forms.

5.7 Quality Control

In addition to periodic calibration of field equipment and the completions of the appropriate documentation, quality control (QC) samples will be collected during sampling events. QC samples may include field blanks, field duplicates, and trip blanks. Definitions of each can be found below as described by the EPA EISOPQAM:

- **Field Blank:** A sample collected using organic-free water, which has been run over/through sample collection equipment. These samples are used to determine if contaminants have been introduced by contact of the sample medium with sampling equipment. Equipment field blanks are often associated with collecting rinse blanks of equipment that has been field cleaned.

- **Field Duplicates:** Two or more samples collected from a common source. The purpose of a duplicate sample is to estimate the variability of a given characteristic or contamination associated with a population.

- **Trip Blank:** A sample, which is prepared prior to the sampling event in the actual container and is stored with the investigative samples throughout the sampling event. They are often packaged for shipment with the other samples and submitted for analysis. At no time after their preparation are trip blanks to be opened before they reach the laboratory. Trip blanks are used to determine if samples were contaminated during storage and/or transportation back to the laboratory (a measure of sample handling variability resulting in positive bias in contaminant concentration). If samples

are to be shipped, trip blanks are to be provided with each shipment but not for each cooler.

5.8 Field Quality Assurance / Quality Control (QA/QC)

All sampling procedures will be conducted in accordance with EPA EISOPQAM. More information on field QC can be found in Sections 4.7 through 4.9.

QA/QC specifications for selected field measurements are summarized below.

Analysis	Control Parameter	Control Limit	Corrective Action
Air Monitoring	Check Calibration of OVA daily	Calibrate to manufactures specifications	Recalibrate. If unable to calibrate, replace.
pH of water	Continuing calibration check of pH 7.0 buffer	pH = 7.0	Recalibrate. If unable to calibrate, replace electrode.
Specific Conductance of water	Continuing calibration check of standard solution	> 1% of standard	Recalibrate.

5.9 Record Keeping

In addition to required sampling documentation (see Section 4.8), standardized forms, log sheets and logbooks will be completed during all field activities.

6.0 SITE MANAGEMENT AND BASE SUPPORT

Throughout the investigation activities, work on the CNC will be coordinated through SOUTHDIV and SCDHEC.

The primary contacts for each are as follows:

1. SOUTHDIV point of contact
   Gabe Magwood
   Southern Division Engineering Command
   2155 Eagle Drive
   North Charleston, SC 29406
   (843) 820-7307

2. SOUTHDIV point of contact
   Tony Hunt
   Southern Division Engineering Command
   2155 Eagle Drive
   North Charleston, SC 29406
   (843) 820-5525

3. SCDHEC point of contact
   Michael Bishop
   South Carolina Department of Health and Environmental Control
   2600 Bull Street
   Columbia, SC 29201
   (843) 898-4300

7.0 REFERENCES

Conoco Inc., 1996. Concawe Diesel Fuel/Kerosene

E/A&H (EnSafe/Allen & Hoshall, Inc.), 1996. Zone H RCRA Facility Investigation Report, Naval Base Charleston, Charleston, South Carolina, 1996.

South Carolina Department of Health and Environmental Control 1999. Risk-Based Corrective Action.

Tetra Tech NUS, Inc. November 1999. Rapid Assessment Report for Site 25, Building 1346, Zone F, North Charleston, South Carolina.

United States Environmental Protection Agency. 1996. EPA Environmental Investigations Standard Operating Procedures for Quality Assurance Manual.

SPORTENVDETCHASN. 1996. UST Assessment Report.

SPORTENDETCHASN (Supervisor of Ship Building, Conversion and Repair, United States Navy, Portsmouth, Virginia, Environmental Detachment Charleston), 1999. Personal contact between Paul Calligan TTNUS and Copes Wannamacker SPORTENDETCHASN, June 17, 1999.

TABLE 1

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR SOIL
SITE 6, BUILDING 648
ZONE H, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Laboratory Screening Data (PPB)[1]				
			Benzene	Toluene	Ethylbenzene	Total Xylenes	Diesel Range Organics
CNC06-B01	06SFB0102	2	<0.5	<0.5	<0.5	3.04	57,389.03
CNC06-B02	06SFB0203	3	<0.5	<0.5	6.85	3.98	74,054
CNC06-B03	06SFB0303	3	1.78	<0.5	<0.5	<1.0	284,737.55
CNC06-B04	06SFB0405	5	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B05	06SFB0506	6	<0.5	<0.5	<0.5	<1.0	2,940.03
CNC06-B06	06SFB0607	7	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B07	06SFB0707	7	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B08	06SFB0801	1	<0.5	<0.5	<0.5	<1.0	340.44
CNC06-B09	06SFB0904	4	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B10	06SFB1006	6	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B11	06SFB1109	9	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B12	06SFB1204	4	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B13	06SFB1304	4	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B14	06SFB1404	4	<0.5	<0.5	<0.5	<1.0	748.86
CNC06-B15	06SFB1504	4	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B16	06SFB1604	4	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B17	06SFB1704	4	<0.5	<0.5	<0.5	<1.0	<100

NOTES:
[1] Laboratory screening data were analyzed using USEPA Method 8260. Compounds not detected are reported as less than the instrument detection limit.
PPB - parts per billion

TABLE 2

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 6, BUILDING 648
ZONE H, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

SOIL BORING/ SAMPLE NO.	SAMPLE DATE	Benzene (ug/kg)	Toluene (ug/kg)	Ethylbenzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL [1]		5	478	364	1119	17687	7042	5593	3146	21265	52
CNC06-B02 / 06SLB0203	19-Jan-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06-B04 / 06SLB0405	19-Jan-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06-B05 / 06SLB0506	19-Jan-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06-B06 / 06SLB0607	19-Jan-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06-B08 / 06SLB0801	19-Jan-99	ND	ND	ND	ND	ND	403	ND	ND	ND	ND
CNC06-B09 / 06SLB0904	19-Jan-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

ND - not detected

ug/kg - micrograms per kilogram

(J) Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

[1] RBSL - South Carolina Department of Health and Environmental Control-Risk Based Screening Levels for clay-rich soils, depth to groundwater less than 5 feet.

TABLE 3

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR GROUNDWATER
SITE 6, BUILDING 648
ZONE H, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Laboratory Screening Data (PPB)[1]				
		Benzene	Toluene	Ethylbenzene	Total Xylenes	Diesel Range Organics
CNC06-P01	06GFP0101	<0.5	<0.5	<0.5	<1.0	232.89
CNC06-P02	06GFP0201	<0.5	<0.5	<0.5	<1.0	58.86
CNC06-P03	free product					
CNC06-P04	06GFP0401	<0.5	<0.5	<0.5	<1.0	<100
CNC06-P05	06GFP0501	<0.5	0.61	<0.5	<1.0	<100
CNC06-P06	06GFP0601	<0.5	0.48	<0.5	0.72	1,432.74
CNC06-P07	06GFP0701	<0.5	0.65	<0.5	<1.0	351.90
CNC06-B08	06GFP0801	<0.5	<0.5	<0.5	<1.0	169.28
CNC06-P09	06GFP0901	<0.5	<0.5	<0.5	<1.0	133.01
CNC06-P10	06GFP1001	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B11	06GFB11	<0.5	<0.5	<0.5	<1.0	252.05
CNC06-B12	06GFB12	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B13	06GFB13	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B14	06GFB14	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B15	06GFB15	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B16	06GFB16	<0.5	<0.5	<0.5	<1.0	<100
CNC06-B17	06GFB17	<0.5	<0.5	<0.5	<1.0	<100

Notes:
[1] Laboratory screening data were analyzed using USEPA Method 8260. Compounds not detected are reported as less than the instrument detection limit.
PPB - parts per billion
free product - free floating petroleum product was present at this location

TABLE 4

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 6 BUILDING 648
ZONE H, CHARLESTON NAVAL BASE COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

MONITORING WELL / SAMPLE NO.	SAMPLE DATE	Benzene (ug/l)	Toluene (ug/l)	Ethyl-benzene (ug/l)	Xylenes (TOTAL) (ug/l)	MTBE (ug/l)	Benzo(a) anthracene (ug/l)	Benzo(a) pyrene (ug/l)	Benzo(b) fluoranthene (ug/l)	Benzo(ghi) perylene (ug/l)	Benzo(k) Fluoranthene (ug/l)	Chrysene (ug/l)	Dibenzo(a,h) anthracene (ug/l)	Naphthalene (ug/l)
RBSL [1]		5	1000	70	10000	40	10[2]	10[2]	10[2]	10[2]	10[2]	10[2]	10[2]	10[2]
CNC06M01 / 06GLM0101	07-Mar-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06M01 / 06GLM0101D [3]	07-Mar-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.38 [J]
CNC06M02 / 06GLM0201	07-Mar-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06M03 / 06GLM0301	07-Mar-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06M04 / 06GLM0401	07-Mar-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06M05 / 06GLM0501	07-Mar-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06M06 / 06GLM0601	07-Mar-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CNC06M07 / 06GLM0701	07-Mar-99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

ND - not detected

ug/l - micrograms per liter.

[J] Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

[1]SCDHEC RBSL - South Carolina Department of Health and Environmental Control-Risk Based Screening Levels

[2]The Risk Based Screening Level for Individual PAH CoC is 10 ug/L for PAH's.

[3] Duplicate

TABLE 5

COMPARISON OF MAXIMUM CONCENTRATIONS TO RBSLs
SITE 6, BUILDING 648
ZONE H, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Chemical of Concern	Maximum Concentration (Soil) (mg/kg)	RBSLs (Soil) (mg/kg)[a]	Maximum Concentration (GW) (mg/L)	Tier 1 RBSLs (GW) (mg/L)[b]	RBSLs (GW) Protective of On-Site Construction Worker[c]
Benzene	0.00178	0.005	0.31[d]	0.005	0.15
Toluene	ND	0.478	4.65[d]	1	5.38
Ethybenzene	0.00685	0.364	0.1[d]	0.7	6.05
Xyienes	0.00398	1.119	0.79[d]	10	102.33
Benzo(a)anthracene	ND	17.687	-	0.010	-
Benzo(b)fluoranthene	0.403	7.042	-	0.010	-
Benzo(k)fluoranthene	ND	5.593	-	0.010	-
Chyrsene	ND	3.146	-	0.010	-
Dibenzo(a,h)anthracene	ND	21.265	-	0.010	-
Naphthalene	ND	0.052	23.35[d]	0.010	1.63

(a) - From Risk-Based Corrective Action for Petroleum Releases, Table B4, Depth to GW - <5 ft, SCDHEC RBCA Guidelines, 1998.
(b) - From Risk-Based Corrective Action for Petroleum Releases, Table B1, SCDHEC RBCA Guidelines, 1998.
(c) - Calculated for dermal, incidental ingestion, and inhalation routes for the on-site construction worker (see Section 3.5.1 of the text and Appendix H).
(d) - Groundwater concentration in equilbrium with free product as calculated using Raoult's Law.
GW - Groundwater
RBSLs - Risk Based Screening Levels
ND - Not detected
NA - Not analyzed
Shaded cell indicates the concentration exceeded one of the RBSLs.

TABLE 6

COMPARISON OF MAXIMUM GROUNDWATER CONCENTRATIONS TO SSTLs
SITE 6, BUILDING 648
ZONE H, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Chemical of Concern	Source Area Concentration (mg/L)	SSTLs Protective of Surface Water (Cooper River)		SSTLs Protective of Construction Workers	Minimum On-Site SSTLs[a]
		$SSTL_{SOURCE}$ (mg/L)	$SSTL_{COMP}$ (mg/L)	$SSTL_{SOURCE}$ (mg/L)	(mg/L)
Benzene	0.31	0.998	0.943	0.15	0.15
Toluene	4.65	199.5	188.5	5.38	5.38
Ethylbenzene	0.10	139.7	132	6.05	6.05
Xylenes	0.79	1995	1885	102.33	102.33
Naphthalene	23.35	2	1.89	1.63	1.63

mg/L - milligrams per liter
GW - Groundwater
Shaded cell indicates the concentration exceeded the SSTL.

(a) The minimum on-site SSTLs are chosen as those SSTLs protective of both surface water (the Cooper River) and the on-site construction worker.

TABLE 7

GROUNDWATER ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN
APRIL 10, 2001
SITE 6, BUILDING 648
ZONE H, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Monitoring Well I.D.	Benzene (µg/l)	Ethylbenzene (µg/l)	Toluene (µg/l)	Xylenes (Total) (µg/l)	Naphthalene (µg/l)
RBSL [1]	**5**	**700**	**1,000**	**10,000**	**10**
CNC06-M01	<1.0	<1.0	<1.0	<3.0	0.32J
CNC06-M02	<1.0	<1.0	<1.0	<3.0	0.24J
CNC06-M02 (dup)	<1.0	<1.0	<1.0	<3.0	0.16J
CNC06-M03	<1.0	<1.0	<1.0	<3.0	0.23J
CNC06-M04	<1.0	<1.0	<1.0	<3.0	0.27J
CNC06-M05	<1.0	<1.0	0.26J	<3.0	0.21J
CNC06-M06[2]	<1.0	<1.0	<1.0	<3.0	0.18J
CNC06-M07	<1.0	<1.0	<1.0	<3.0	0.21J
CNC06-P01	<1.0	<1.0	<1.0	<3.0	0.35J
CNC06-P06	<1.0	<1.0	<1.0	<3.0	0.17J
CNC06-P07	<1.0	<1.0	<1.0	<3.0	0.16J
CNC06-P10	<1.0	<1.0	<1.0	<3.0	0.17J
Trip Blank	<1.0	<1.0	0.42J	<3.0	0.30J

Notes:

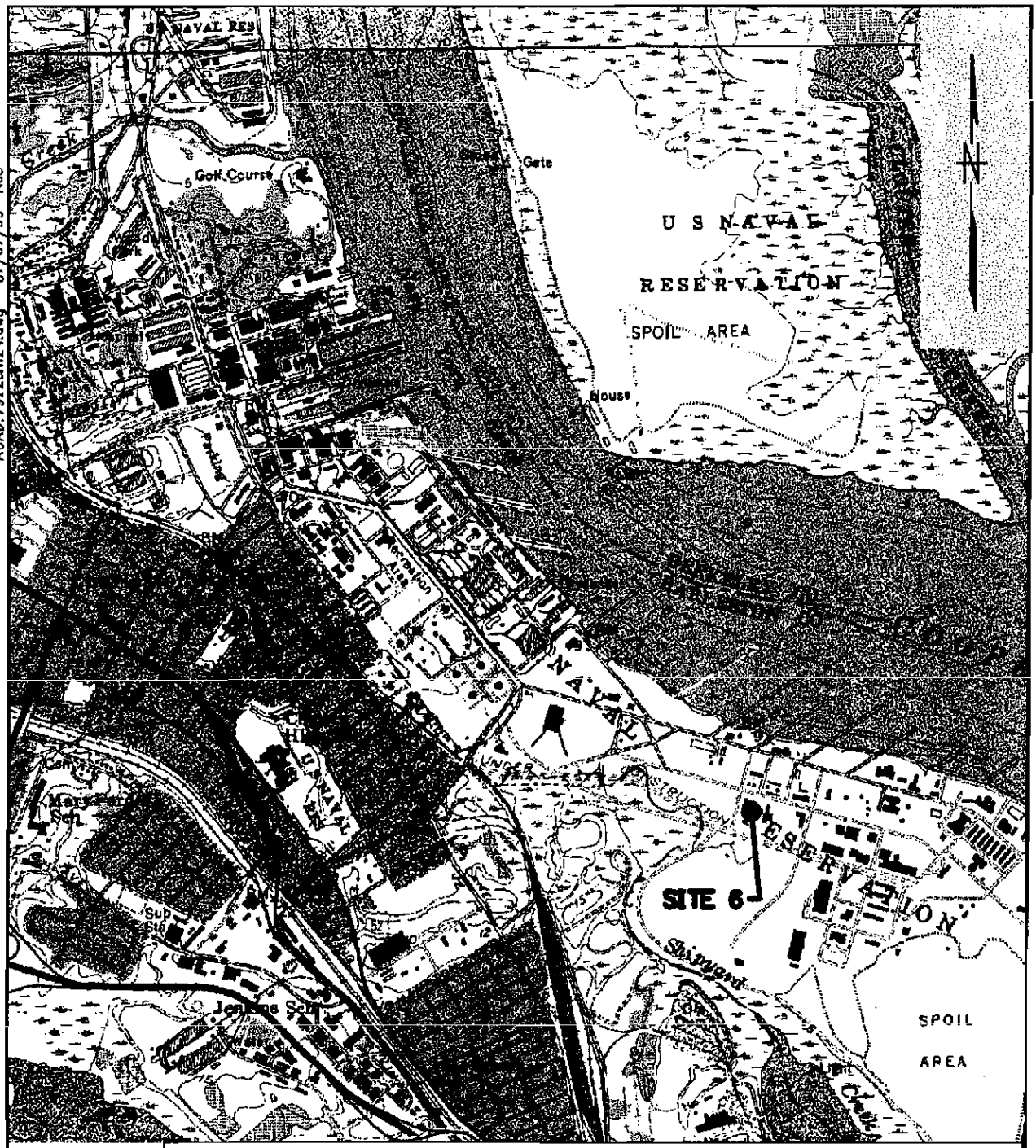
[1] RBSL for groundwater

[2] Historical presence of free product in well NBCT200TW01

dup = Duplicate sample

J = Analyte is present at a concentration that is less than the reporting limit and greater than the detection limit.

FIGURES



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SOURCE: QUADRANGLE MAP SOUTH CAROLINA, REVISED 1979
QUADRANGLE MAP NORTH CHARLESTON REVISED, 1979

0 2000 4000
SCALE IN FEET

DRAWN BY DATE: HJP 7/1/99		SITE LOCATION MAP SITE 6, BUILDING 648 ZONE H, CHARLESTON NAVAL COMPLEX NORTH CHARLESTON, SOUTH CAROLINA	CONTRACT NO. 7912
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE: AS NOTED			DRAWING NO. FIGURE 1 / REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

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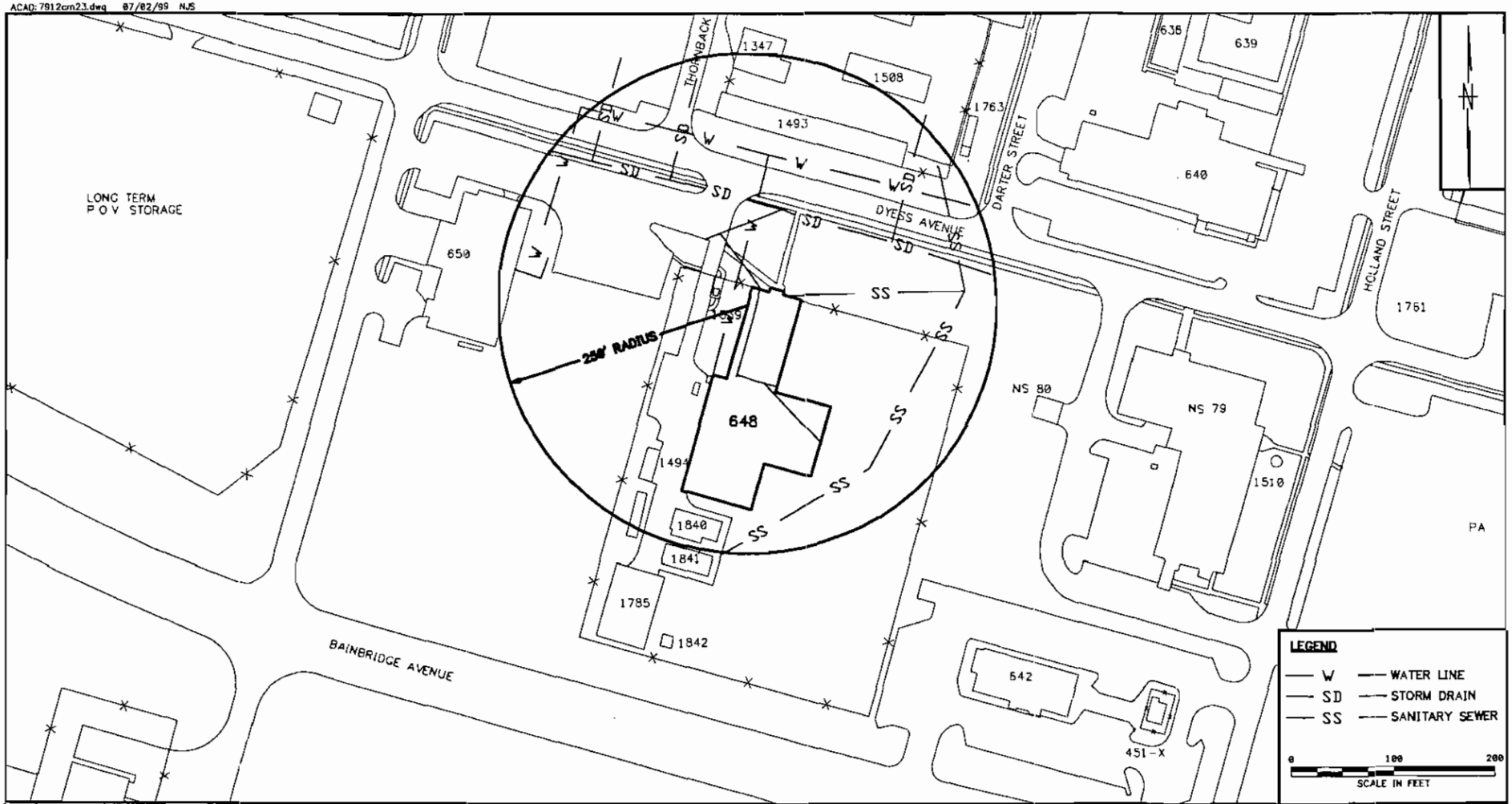

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY KW DATE 5/24/99
CHECKED BY DATE
COST/SCHED—AREA
SCALE AS NOTED

SITE VICINITY MAP
SITE 6, BUILDING 648
ZONE H, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 7912
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2
REV. 0

FORM CADD NEL 3GIV_BASDWG - REV 0 - 1/20/98

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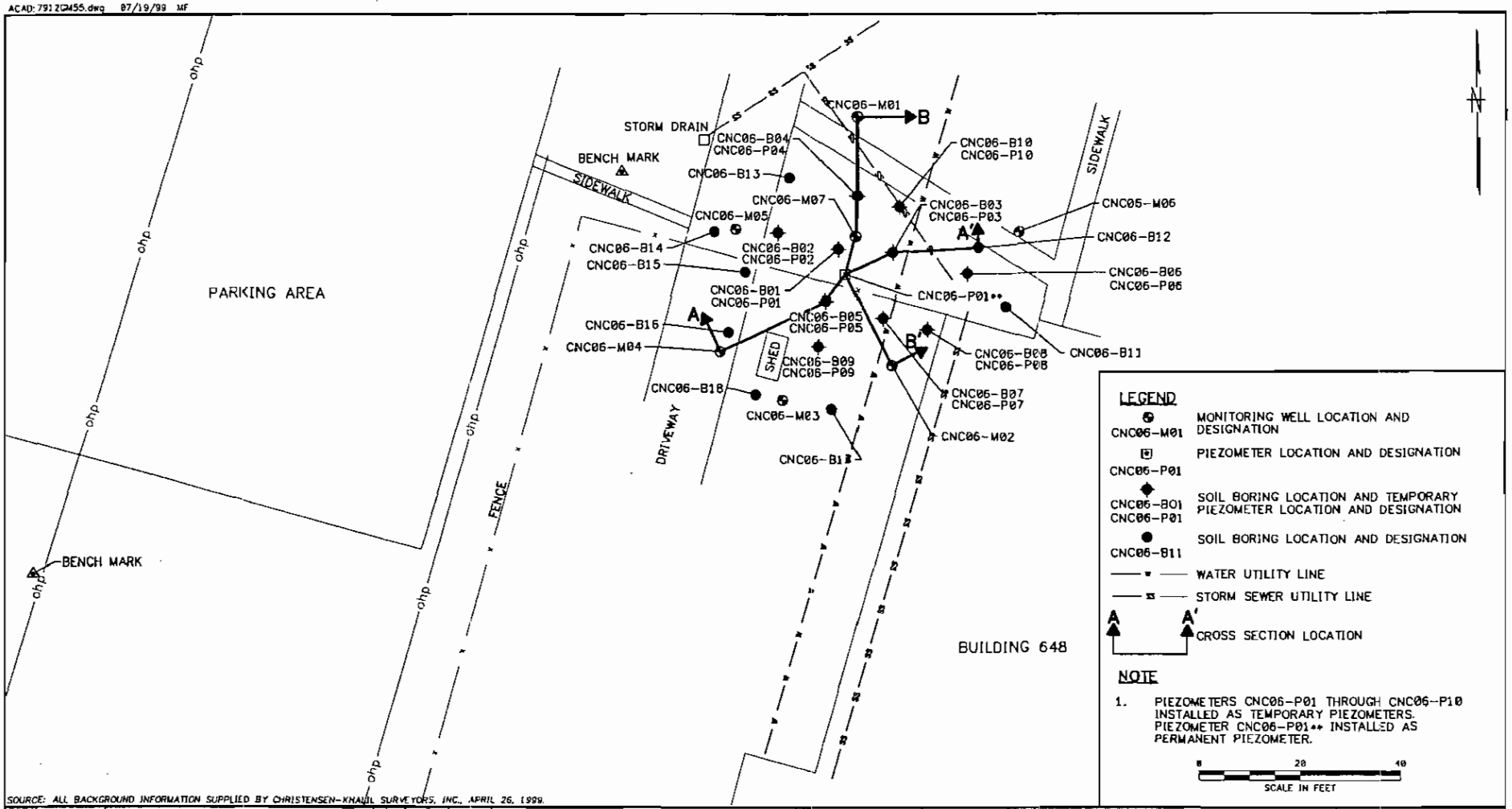

SOURCE: ALL BACKGROUND INFORMATION SUPPLIED BY CHRISTENSEN-KHALIL SURVEYORS, INC., APRIL 26, 1999.

NO.	DATE	REVISIONS	BY	CHKD	APP'D	REFERENCES

DRAWN BY MF DATE 7/16/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

SITE MAP
SITE 6 BUILDING 648
ZONE H, CHARLESTON NAVAL COMPLEX
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 7912
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 3
REV. 0

FORM CADD NO. SOIL_SH.DWG - REV 0 - 1/20/98

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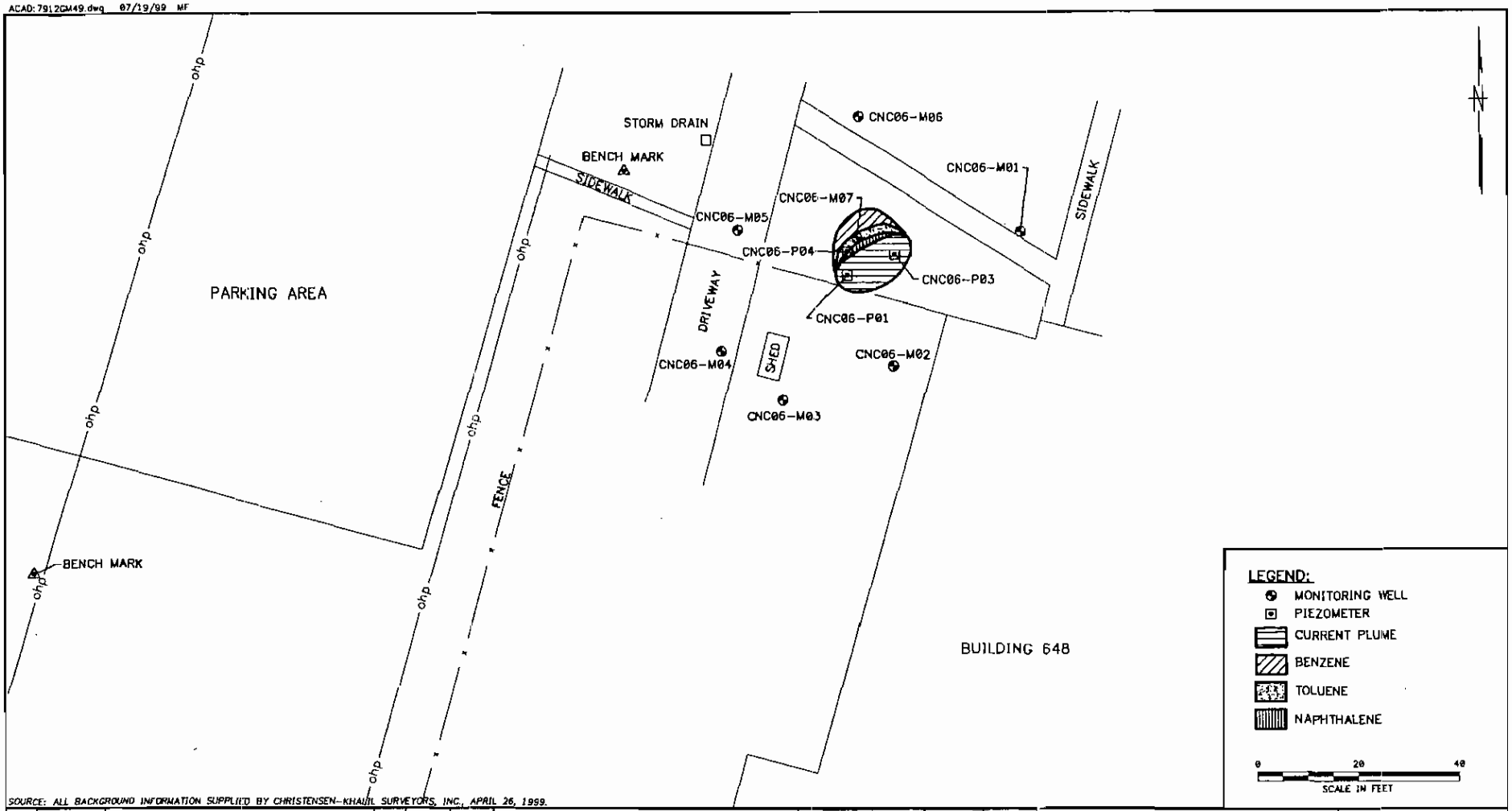

SOURCE: ALL BACKGROUND INFORMATION SUPPLIED BY CHRISTENSEN-KHALIL SURVEYORS, INC., APRIL 26, 1999.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 7/15/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PREDICTED 10 YEAR MIGRATION
SITE 6 BUILDING 648
ZONE H, CHARLESTON NAVAL COMPLEX
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 7912
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4
REV. 0

FORM CADD NO. SDN_GHLDWG - REV D - 1/20/98

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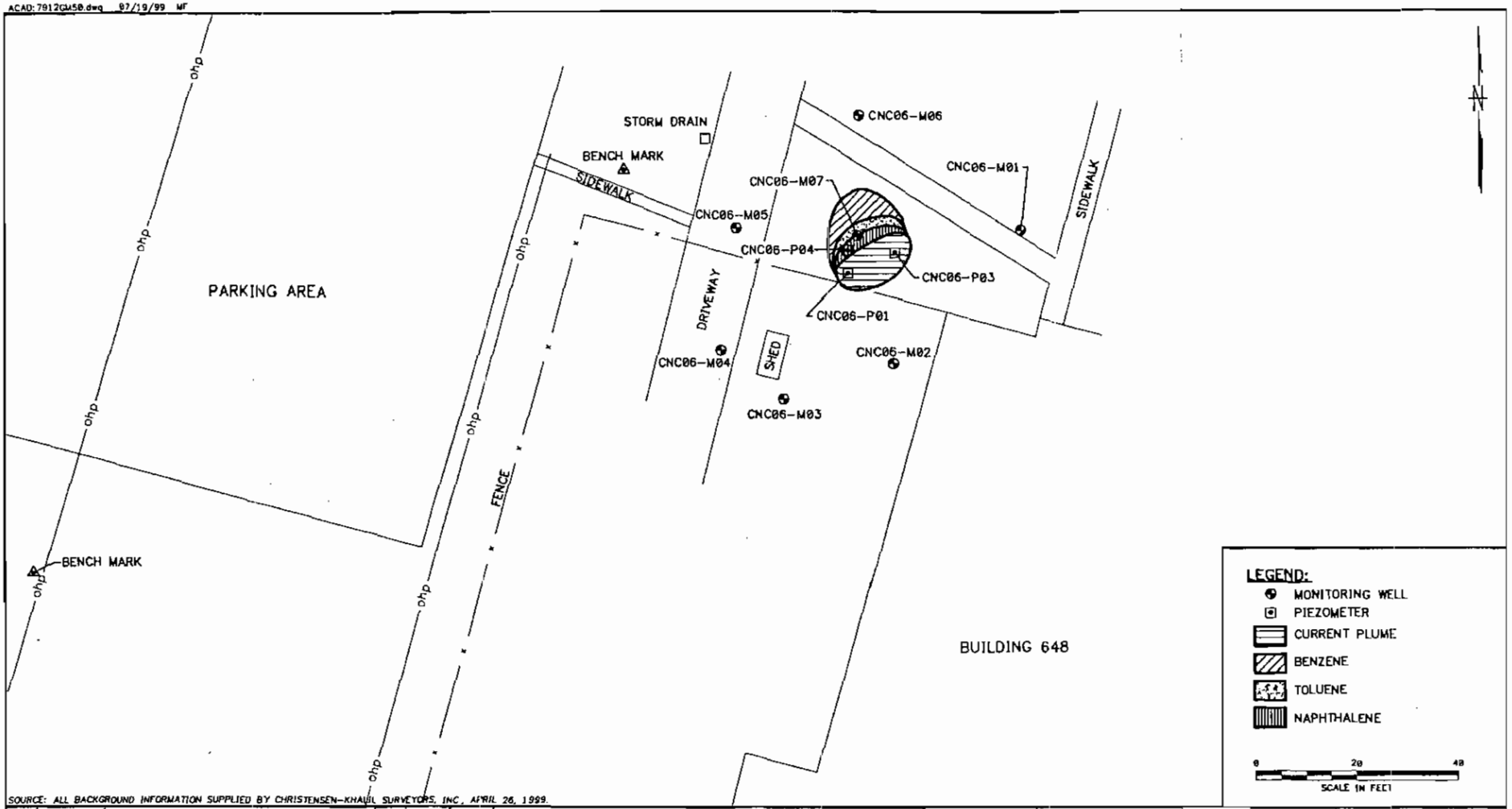

SOURCE: ALL BACKGROUND INFORMATION SUPPLIED BY CHRISTENSEN-KHALIL SURVEYORS, INC., APRIL 26, 1999.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 7/15/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PREDICTED 20 YEAR MIGRATION
SITE 6 BUILDING 648
ZONE H, CHARLESTON NAVAL COMPLEX
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 7912
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 5
REV. 0

FORM CADD NO. SDN_BLDNG - REV 0 - 1/20/98

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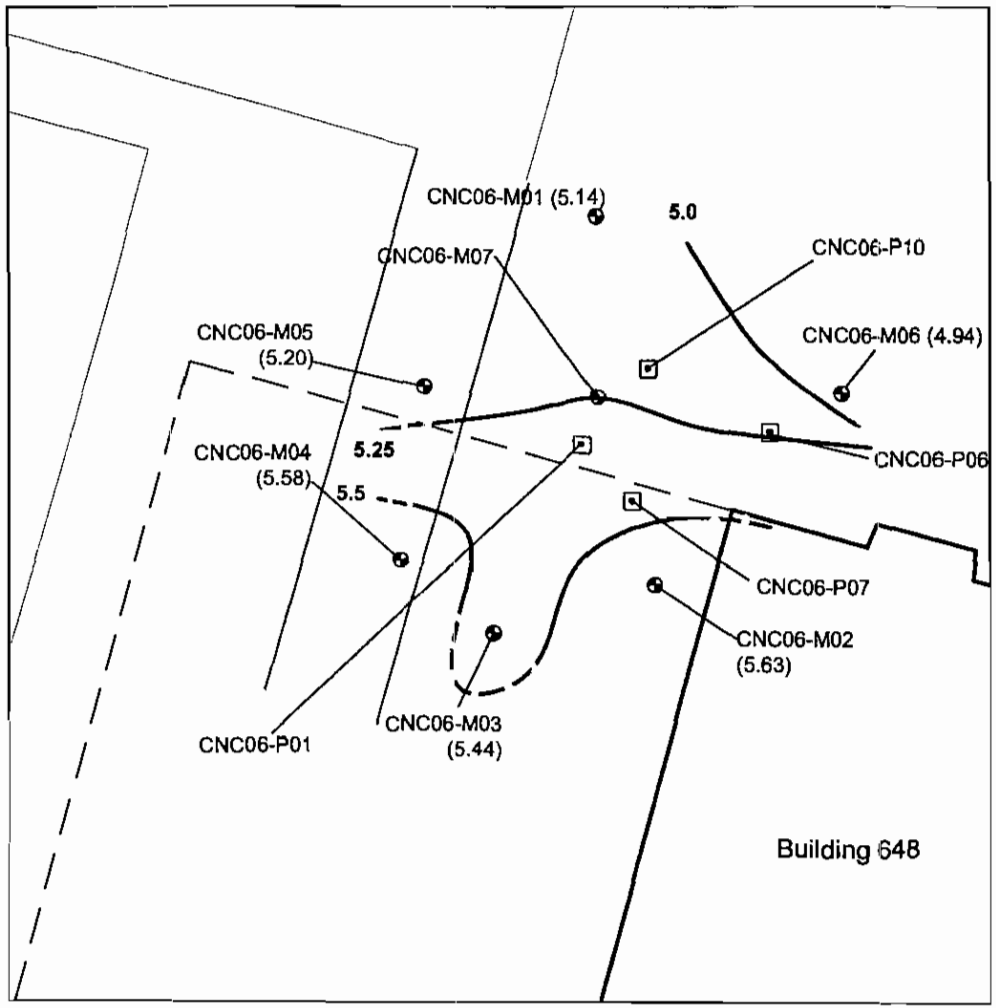

Legend:

Samples: Groundwater Samples

- Groundwater Well
- Piezometer Location
- Road - Line
- Fence
- Buildings
- Groundwater Potentiometric Surface Contour (MSL) - Dashed is inferred contour

Contour Interval = 0.25 Foot

(4.15) Groundwater Elevation (MSL)

Note: Groundwater elevation from Piezometer CNC06-M07 not used in contour map.

N
W E
S

Scale (ft)
0 50

REV#	DESCRIPTION	APP'D

J.A. JONES ENVIRONMENTAL SERVICES
McLaren-Hart/Jones
A subsidiary of J.A. Jones Environmental Services

Groundwater Potentiometric Surface Map 3/10/01

Site 6, Building 648, Zone H, Charleston Naval Complex
North Charleston, South Carolina

DRWN: DTB	SCALE: AS SHOWN
CHK'D:	DATE: 04/30/01
APP'D:	**FIGURE 6**

APPENDIX A

Groundwater Analytical Report (April 10, 2001)

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646002
Sample Location:
Sample Date: 11-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648HWM02L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.16	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
----------	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.2	
2037-26-5	Toluene-d8	47.9	
1868-53-7	Dibromofluoromethane	48.6	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646003
Sample Location:
Sample Date: 11-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWM02L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.24	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
----------	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	44.3	
2037-26-5	Toluene-d8	46.7	
1868-53-7	Dibromofluoromethane	48.2	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646004
Sample Location:
Sample Date: 11-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWM03L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.23	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.6	
2037-26-5	Toluene-d8	46.8	
1868-53-7	Dibromofluoromethane	48.8	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646005
Sample Location:
Sample Date: 11-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWM04L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.27	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
----------	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.2	
2037-26-5	Toluene-d8	47.7	
1868-53-7	Dibromofluoromethane	48.5	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646006
Sample Location:
Sample Date: 11-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWM05L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.21	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	0.26	J
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.2	
2037-26-5	Toluene-d8	47.6	
1868-53-7	Dibromofluoromethane	48.9	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646007
Sample Location:
Sample Date: 10-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWM06L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.18	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
----------	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.6	
2037-26-5	Toluene-d8	48.4	
1868-53-7	Dibromofluoromethane	48.7	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646008
Sample Location:
Sample Date: 11-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWM07L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.21	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.6	
2037-26-5	Toluene-d8	47.3	
1868-53-7	Dibromofluoromethane	48.4	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646009
Sample Location:
Sample Date: 10-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWP01L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.35	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	43.5	
2037-26-5	Toluene-d8	46.3	
1868-53-7	Dibromofluoromethane	49.9	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646010
Sample Location:
Sample Date: 10-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWP06L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.17	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
----------	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.3	
2037-26-5	Toluene-d8	48.1	
1868-53-7	Dibromofluoromethane	48.8	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646011
Sample Location:
Sample Date: 11-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWP07L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.16	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
----------	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.3	
2037-26-5	Toluene-d8	48.5	
1868-53-7	Dibromofluoromethane	47.9	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646012
Sample Location:
Sample Date: 10-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWP10L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.17	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	45.4	
2037-26-5	Toluene-d8	47.4	
1868-53-7	Dibromofluoromethane	48.2	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646001
Sample Location:
Sample Date: 10-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648GWM01L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.32	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	1.0	U
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	44.0	
2037-26-5	Toluene-d8	46.8	
1868-53-7	Dibromofluoromethane	49.0	

General Engineering Laboratories, Inc.

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 40646013
Sample Location:
Sample Date: 10-APR-2001
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: |VOA8260BLF|

Client SDG: 40646
Client Smp ID: 648TW001L2
Sample Point:
Date Received: 12-APR-2001
Quant Type: ISTD
Level: LOW
Operator: VJ

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/l	Q
91-20-3	Naphthalene	0.30	J
71-43-2	Benzene	1.0	U
108-88-3	Toluene	0.42	J
1330-20-7	Xylenes (total)	3.0	U
95-47-6	o-Xylene	1.0	U
	m,p-Xylenes	2.0	U
100-41-4	Ethylbenzene	1.0	U
460-00-4	Bromofluorobenzene	40.6	
2037-26-5	Toluene-d8	44.3	
1868-53-7	Dibromofluoromethane	47.2	